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(54) Filtration of thick gluten

(57) The filtration of thick gluten which is obtained as a by-product of the manufacture of maize starch can be improved by the action before or during filtration of an amylase- and proteinase-free xylanase, hemicellulase and/or glucanase and results in more rapid removal of water and in retention of the starch content of the thick gluten.

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SPECIFICATION

Filtration of thick gluten

The present invention relates to a process for the filtration of thick gluten. More particularly it relates to a process for the filtration of gluten with the addition of enzymes before or during the filtration.

During the production of maize starch it is necessary to remove the protein constituents of the maize, i.e. the maize gluten. This generally takes place after wet milling of the maize by a sequence of working steps to remove germs and fibrous material and to centrifuge down the starch. During such centrifugation, a fraction comprising the gluten and mechanically damaged starch grains is obtained as centrifugate. This fraction is called thick gluten. Water is removed from it on drum filters, and it is dried and used as protein-rich livestock feed.

Problems often arise during the filtration of thick gluten. Water is often obstinately retained so that only a small amount of filtrate is obtained, and the residue has a correspondingly high water content, necessitating a large amount of heat energy to dry it. This problem is attributed to the swelling of the starch contained in the thick gluten.

US-A-3 928 631 suggests that highly branched polysaccharides, some of which are insoluble, are responsible for the problems experienced during filtration. Addition of glucoamylase to the thick gluten at least one hour before starting the filtration results in substantial degradation of the starch and marked improvement in the filterability. However, this amylase treatment has the disadvantage that the starch, which would otherwise remain as a valuable feed component in the residue, is lost in the form of dissolved dextrins and sugars. Moreover, part of the filtrate is used for swelling the maize. This introduces an amylase, which is still contained therein, into the milling material and brings about the breakdown of starch, by which means another fraction thereof is lost. Another part of the filtrate is discarded and, owing to its content of starch breakdown products, interferes with sewage purification.

We have now found that problems associated with the filtration of thick gluten can be reduced by enzymatic treatment of the thick gluten before or during filtration if the enzyme used is a xylanase, a hemicellulase and/or a glucanase, which is substantially free of amylases and proteinases.

This result is surprising because maize contains only very small amounts of swelling substances with the hemicellulase structure, and it was not known that swelling substances of this type are present in thick gluten. We assume - without wishing to be bound by theoretical considerations - that the starch, or starch-like insoluble polysaccharides contained in thick gluten do not in fact cause the filtration problems and that it is only by an interaction between the small quantity of hemicellulases and the starch particles or the undissolved polysaccharides that there is a production of structures resembling swelling substances, which cause the filtration problems described. This would explain why it is possible to avoid the formation of the swelling substances, and to eliminate the filtration problems, both by breakdown of starch and by breakdown of the hemicellulases which were not hitherto known.

Therefore, according to the present invention we provide a process for the filtration of thick gluten which includes the steps of adding to thick gluten before or during the filtration a xylanase, a hemicellulase and/or a glucanase enzyme which is substantially free of amylases and proteinases.

Enzyme preparations which have a sufficient xylanase, hemicellulase and/or glucanase activity are known and are commercially available. They may originate from cultures of bacteria or moulds, for example trichoderma. Such activities may also be present as a secondary activity in addition to another main activity as long as the latter does not adversely affect the process. The enzyme preparation should most desirably be substantially free of amylase and proteinase activity effective at the thick gluten pH of 3.5 - 4.5, because otherwise there would be undesired breakdown of starch and gluten. Traces of these activities, as are detectable in most enzyme preparations, are undesirable if they cause neglible breakdown of starch and gluten. Likewise, amylases and proteases which are active only outside the pH range of thick gluten are, in general, undesirable for the process.

Extremely small amounts of the enzymes which are used according to the invention are conveniently required, and they have no economic significance beside the retention of the quantity of starch in thick gluten. Enzyme preparations with a xylanase activity of 50 to 10,000 UXyl/g at pH 3.5 - 4.5 are preferably used in an amount of 0.05 to 10 kg/t of gluten dry matter. An action time of 30 to 60 min at 35 to 45°C is adequate. The hold-up time of the thick gluten in the filtration system can be included in the calculated treatment time so that, where the hold-up time is sufficiently long, it is unnecessary to add the enzyme until the filtration system is entered.

The action of the enzymes used according to the invention does not fully reach that of glycoamylase. The solids content in the residue is at least 0.5% higher, and there is at least 5% more filtrate. Although even this improvement is of economic significance, as a rule even more favourable figures can be reached, for example an increase in the solids content of 1 to 3% and an augmentation of the amount of filtrate by 10 to 30%. This not only increases the nutritional value of the gluten feed but also at the same time reduces the energy required for drying.

The invention will now be illustrated by the following non-limiting Examples:

Examples

Procedure

A homogenised gluten suspension is equilibrated at 40°C, with stirring. The enzyme which is to be tested is metered in at a dosage of 0.24% (based on gluten dry matter), and a reaction time of 30 minutes is observed. An exactly defined amount (150.0 g) of the suspension is filtered under reduced pressure for exactly 2 minutes, and the amount of filtrate is determined. Then filtration under reduced pressure is carried out again for exactly 1 minute, and the amount of filtrate is determined once more. To determine the residual moisture, 10 g of residue are triturated with 10 g of sea sand and dried at 120°C to constant weight (determination of the dry content).

Filtration test

1) *Filtration at 20 Torr*

After the reaction time, filtration under reduced pressure was carried out for 2 and 3 minutes.

Enzyme	Filtrate after 2 minutes		Filtrate after 3 minutes		Dry matter in residue (% by weight)
	g	%	g	%	
Blank without enzyme	38.7	100	47.9	100	26.4
Mould Cellulase (1)	41.3	106.7	50.7	105.9	28.0
Cellulase (2)	42.8	110.6	53.7	112.1	28.7
Cellulase (3)	48.9	126.4	59.9	125.1	29.3

Mould cellulase preparation 1 has an activity of 330 CU/mg and 610 UXyl/g and increases the amount of filtrate by 6.7%. Preparation 2 has an activity of 100 CU/mg and 3000 UXyl/g and increases the amount of filtrate by 10.6%. A specific combination of xylanase and cellulase, 1500 CU/mg and 120 UXyl/g in Preparation 3 increases the filtration yield by 26.4% after 2 minutes.

2) *Filtration at 16 Torr*

The parameters are the same as in Example 1.

Enzyme	Filtrate after 2 minutes		Filtrate after 3 minutes	
	g	%	g	%
Blank without enzyme	42.0	100	51.7	100
Mould Cellulase (1)	45.5	108.5	55.9	108.1
Cellulase (2)	51.2	122.0	63.5	122.9
Cellulase (3)	56.4	134.4	68.5	132.5

The sequence of enzyme activities remains the same.

CLAIMS

1. A process for the filtration of thick gluten which includes the steps of adding to thick gluten before or during the filtration a xylanase, a hemicellulase and/or a glucanase enzyme which is substantially free of amylases and proteinases.

2. A process as claimed in claim 1 wherein said xylanase, hemicellulase and/or glucanase enzyme is substantially free of amylases and proteinases at the thick gluten pH of 3.5-4.5.

3. A process as claimed in claim 1 or claim 2 wherein the enzyme added has a xylanase activity of 50 to 10000 UXyl/g at pH 3.5-4.5 and is used in an amount of 0.05 to 10 kg/t gluten dry matter.

4. A process as claimed in claim 1 substantially as hereinbefore described.

5. A process as claimed in claim 1 substantially as hereinbefore described with reference to the Examples.

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